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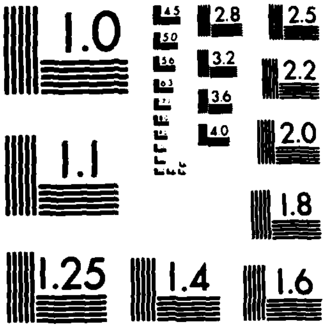

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FEASIBILITY STUDY ON STANDARD CRITERIA FOR CONTROL SYSTEMS FACILITIES PHASE I

PREPARED FOR COMMANDER, US ARMY MUNITIONS PRODUCTION BASE MODERNIZATION AGENCY
DOVER, NEW JERSEY

U.S. ARMY
CORPS OF ENGINEER
HUNTSVILLE DIVISION

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

THIS STUDY WAS CONDUCTED TO DETERMINE THE FEASIBILITY OF STANDARDIZATION OF CERTAIN CONTROL SYSTEMS FACILITIES. EXISTING PLANTS WERE SURVEYED TO ASSESS CURRENT PRACTICE. INDUSTRY WAS SURVEYED TO DETERMINE FUTURE TRENDS. EVALUATION OF THE RESULTS INDICATED THAT IT IS FEASIBLE TO IMPLEMENT A CERTAIN DEGREE OF STANDARDIZATION. RECOMMENDATIONS ARE MADE FOR THE CONDUCT OF THE NEXT PHASE OF THIS STUDY, PHASE II, INCLUDING A SCOPE OF WORK, COST AND BUDGET ESTIMATE.

FEASIBILITY STUDY ON STANDARD CRITERIA

FOR CONTROL SYSTEMS FACILITIES

PHASE I

Prepared for

COMMANDER

USA MUNITIONS PRODUCTION BASE MODERNIZATION AGENCY

DOVER, NEW JERSEY

Prepared by

US ARMY ENGINEER DIVISION, HUNTSVILLE

FOREWORD

The Commander, Munitions Production Base Modernization Agency (SARPM-PBM), Dover, New Jersey, authorized the US Army Engineer Division, Huntsville, (USAEDH) to conduct a study to determine the feasibility of standardization of certain features of select control systems facilities. This study was conducted by Arthur T. Bolt under Charles C. Huang, Chief of the Advanced Technology Section. Douglas A. Morlock, Control Systems Officer, PBM, sponsored the study.

This study has been coordinated with the Engineering and Construction Divisions of USAEDH.

In this document feasibility determination is reported and findings are summarized. Recommendations are also made for conducting the next phase of this study.

ABSTRACT

This study was conducted to determine the feasibility of standardization of certain control systems facilities. Existing plants were surveyed to assess current practice. Industry was surveyed to determine future trends. Evaluation of the results indicated that it is feasible to implement a certain degree of standardization.

Recommendations are made for the conduct of the next phase of this study, Phase II, including a scope of work, cost and budget estimate.

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CHAPTER 1

NEED FOR STANDARDIZATION

1-1. BACKGROUND

USAEDH was tasked by the Commander, USA Munitions Production Base Modernization Agency (SARPM-PBM), to study the feasibility of standardization in specified areas on future PBM projects. The first phase of that study, i.e., a feasibility determination, is reported herein. Tasks to be conducted in the second phase also are defined.

Several advantages could be realized from having standard criteria and designs for facilities to house control systems equipment on future PBM projects. The most significant potential advantage is that the impact of hardware on facilities or the constraint of the building on hardware selection would be minimized, i.e., the building configuration and equipment support subsystems in the facilities should be designed (or standardized) such that they could accommodate types of control equipment of different models and makes. Accordingly, building design becomes less sensitive to the change of hardware therein and the probability of building redesign as a result of changing hardware is minimized. Thus, the decision of selecting hardware does not need to be confirmed at the facility design phase which is usually two to three years prior to the construction phase. There is less risk to technical obsolescence of hardware because the commitment to the make and model of hardware could be postponed to a later date consistent with equipment procurement lead time and the planned construction schedule. Improved later models could be utilized with little or no impact.

A second potential advantage would be a reduction in design costs. Appropriate areas of standardization, identified in this study and developed during Phase II, could be selected by designers and applied to the projects on hand. The time thus saved could result in lower design cost.

1-2. STANDARDIZATION GOALS

Presently, control room systems and arrangements are not designed from a consistent set of criteria or from a design methodology which systematically considers these criteria at each stage of the design. The purpose of this study is to determine the feasibility of developing standardized criteria for use in design of control systems facilities.

The criteria should have as a foundation certain design goals and objectives. To determine the feasibility of establishing design criteria, it is important to identify the goals. Once identified, an evaluation of the desirability and practicality of implementing the goals can be made.

The major goal should be design flexibility. The building configuration and equipment support subsystems should be designed to accommodate different models and makes of control equipment, since often there is a transitional period between design and construction. Too often the transition, usually a period of several years, results in equipment changes which were not originally anticipated when designing the room. The outcome could be a redesign of the facility. Standardized criteria should minimize the sensitivity of the building design to the hardware contained in the room. Field installation could be simplified by standardized criteria which would eliminate any major construction costs resulting from last minute changes in hardware. If hardware needs to be replaced, design based on standardized criteria could also ensure adequate and easy access to the control room.

Another goal is the recognition of the human factors in control room operation. Attention should be directed to such items as lighting, space requirements, storage areas, and other items which may adversely affect performance during routine and emergency operations.

Finally, it should be noted that standardized criteria should result in lower design costs since possible alternative designs would not have to be investigated. It is, however, necessary that the standardized criteria be updated periodically to reflect current needs and requirements.

1-3. PRESENT AREAS OF STANDARDIZATION

Numerous areas presently have standardized requirements. These requirements are contract specified documents and specifications. They may be satisfied either by general reference or by specific callout. Reference is made in this study to a representative sample of those used on this program. It is recognized that each does not have universal application on all of the Army Ammunition Plant (AAP) designs.

Table 1-1 is a list of the existing standards and their general area of application.

1-4. DEFINITION OF STANDARDIZATION

Standardization as used herein is defined as an established approach which can be used in the design of a facility, or portion thereof, based on documented experience and information available on developing trends. The approach to be outlined will minimize the designer's options by providing guidelines in specified areas of facility design. The facilities covered are:

a. Local and Process Control Rooms

b. Motor Control Rooms/Centers

c. Interface Rooms

Other facilities were not included in this study since they are more process dependent with a wide variance among plants.

1-5. GENERAL STUDY CONCLUSION

This study concluded that it is feasible to standardize certain aspects of control systems facilities. Detailed results and conclusions are found in Chapter 5.

Table 1-1. Existing Standards

SAFETY	
AMCR 385-100	Safety Manual
AMCR 385-228	Safety Requirements for Manufacturing Small Arms Ammunition
DOD 4145.26M	DOD Contractor's Safety Manual for Ammunition, Explosives and Related Dangerous Materials
OSHA Requirements	Occupational Safety and Health Act of 1970
ARMCOM Safety Bulletin	FY75-2, 24 January 1975
DARCOM 420-1	Contractual Inspection of Boilers, 20 May 1969
LIGHTNING PROTECTION	
AMCR 385-100	Safety Manual, Chapter 8
NFPA	Lightning Protection Code
NAVSEA OP5 Vol 1	Ammunition and Explosives Ashore Storage Data, 15 September 1970
HNDTR-80-41-ED-FD	Lightning Protection Study, US Army Ammunition Plants
GROUNDING	
NEC	National Electric Code
DOD 4145.26M	DOD Contractor's Safety Manual for Ammunition, Explosives and Related Dangerous Materials
NAVSEA OP5 Vol 1	Ammunition and Explosives Ashore Storage Data, 15 September 1970
ENERGY CONSERVATION	
Engineering Technical Letter 1110-3-196, 5 October 1973	Engineering and Design Energy Conservation

Table 1-1. Existing Standards (Continued)

FIRE PROTECTION	
AR 420-90 31 January 1974	Fire Prevention and Protection
AMCR 385-228	Safety Requirements for Manufacturing Small Arms Ammunition
DOD 4145.26M	DOD Contractor's Safety Manual for Ammunition, Explosives and Related Dangerous Materials
NFPA Vol 10	National Fire Protection Association
HEATING, VENTILATION, AIR-CONDITIONING (HVAC)	
ASHRE 90-75	Energy Conservation in New Building Design, 11 August 1975
OSHA Part 1910	Occupational Safety and Health Standards, 1978
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
STRUCTURES	
TM 5-1300	Structures to Resist the Effects of Accidental Explosions
Technical Report 3808	Manual for Design of Protective Structures Used in Explosive Processing and Storage Facilities
TM 5-809-10	Seismic Requirements
AISC-S-32b/78	Specification for the Design, Fabrication and Erection of Structural Steel for Building of the American Institute of Steel Construction

Table 1-1. Existing Standards (Continued)

HUMAN FACTORS	
MIL-STD-1472A	Military Standards Human Engineering Design Criteria for Military Systems, Equipment and Facilities
OSHA Requirements AMCR 385-150	Sound Proofing of Control Areas
SECURITY	
AR 190-11	Military Police Physical Security of Weapons, Ammunition and Explosives
AMCR 190-3	Military Police of Order Activities
CONFIGURATION MANAGEMENT	
PBM OSM 70-1, 1 April 1976	DRCPM-PBM Configuration Management Operating System Manual
ENGINEERING/CONSTRUCTION CRITERIA	
DOD 4270.1M	Construction Criteria Manual
HNDM-1110-1-1	Engineering Guidance Design Manual for Architect-Engineers
LIGHTING	
ANSI A11.1-73 IES RP7-73	American National Standard Practice for Industrial Lighting

CHAPTER 2

STUDY METHODOLOGY

2-1. GENERAL

This study is divided into two phases. Phase I, reported herein, is the feasibility study. Phase II is the development of criteria/designs based upon the results of the Phase I effort. Definition of the second phase is included in the Phase I study.

2-2. STUDY GUIDELINES

Cognizant personnel at SARPM-PBM, AAPs (Government and operating personnel), Black & Veatch and inhouse, were contacted to discuss philosophy and possible areas of standardization, the approach to the problem associated with standardization and the number and location of sites to be investigated. Results of such discussions were used to formulate and update a set of guidelines which reflect the current best thinking on the subject of standardization.

2-3. SCOPE OF STUDY

a. Types of Plants. Each of the three different types of active plants were considered, i.e.,

(1) Metal Parts (MPTS)

(2) Propellants and Explosive (P&E)

(3) Load, Assemble and Pack (LAP)

b. Candidate Facilities. The facilities investigated for standardization are:

(1) Local Control Rooms

(2) Process Control Rooms

(3) Motor Control Rooms/Centers

(4) Interface Rooms

c. Areas Investigated. The areas investigated for possible standardization included:

(1) Structural Aspects

(a) Size

(b) Configuration

(2) Support Systems

(a) Utilities

(b) Environmental Control

(c) Conduit Egress

(3) Safety Systems

(a) Fire Detection/Protection

(b) Lightning Protection

(c) Grounding

(4) Security Systems

Each of these areas of investigation is addressed in Chapter 5 as a category of facility features which are proposed for standardization. See Paragraph 5-1.

d. Review of Existing Facilities. Appropriate drawings and specifications were reviewed to establish current design practice. Discussions were held with designers to obtain their ideas on standardization.

Six AAPs were surveyed. Relevant data on related existing practice were compiled. These plants were surveyed to identify areas which could have features of varying degrees of standardization even though the standardization does not presently exist. The plants surveyed were:

(1)	Indiana AAP - Black Powder	P&E
(2)	Radford AAP	P&E
(3)	Lake City AAP	Small Arms

(4)	Lonestar AAP	LAP
(5)	Louisiana AAP	MPTS
(6)	Sunflower AAP	P&E

e. Industry Survey. A preliminary industry survey was made of representative equipment manufacturers to determine the trends in equipment to be supplied through the early 1980's. Factors considered included trends in size, type of control and general comments on design of control rooms.

CHAPTER 3

PRIORITIZATION BASIS FOR

SELECTION OF STANDARDIZATION CONCEPTS

3-1. PRIORITIZATION OF PLANTS

Initially all three types of active plants were considered. A preliminary conclusion from the initial review indicated that standardization probably would not be cost effective if a single standard was imposed universally on all three types of plants. Because of the unique considerations appropriate to each type of process, standardization could best be applied if it was tailored to each type of process.

Effective standardization is difficult to achieve requiring extensive study with many variables and considerations. Thus, consideration was given to a means of prioritizing the need for standardization. The number of potential candidate plants of each type was the initial consideration. Data for this consideration were obtained from the "Planned Funding Level and Schedule for the Period FY81-FY85" [Reference 1]. For planning purposes only the "core case" is considered. Projects include expansion (EXP), modernization (MOD) and initial production facility (IPF). Total dollars planned are divided between the Office of the Chief of Engineers (OCE) and the US Army Munitions Production Base Modernization Agency, Dover, New Jersey. The OCE dollars are appropriate to this study. Table 3-1 shows a summary of the projects for the FY81-85 period. This table indicates that first priority for standardization should be given to the P&E projects while the LAP projects are considered at a lower priority.

3-2. PRIORITIZATION OF PROJECTS

Table 3-2 defines the projects that are planned for the period. A current issue of this table will serve as the basis of selection for projects which will be subject to standardization. For the modernization projects standardization may be somewhat constrained by existing structural and process constraints.

Time to implement standardization is another consideration. Little standardization impact is expected on the projects scheduled for the near future. Out year projects should all reflect standardization if the decision to implement limited standardization is made.

Table 3-1. Program for FY81-FY85 Core Case/OCE

	FY81	FY82	FY83	FY84	FY84	TOTALS
P&E	2.7	24.9	12	19.7	74.3	133.6
LAP	2.1	.7	12.2	8.7	9.8	33.5
MPTS	52.9	---	---	---	---	52.9
OMN (Omnibus)	5.9	8.7	9.1	9.9	10	43.6
P&E Breakdown						
P&E - IPF	---	---	12	---	---	12
EXP	---	---	---	---	---	0
MOD	2.7	24.9	---	19.7	74.3	121.6
LAP Breakdown						
LAP - IPF	1.2	.7	---	---	9.8	11.7
EXP	---	---	12.2	---	---	12.2
MOD	.9	---	---	8.7	---	9.6

Table 3-2. FY81 - FY85 Projects - Core Case

PROJECT	TITLE	TYPE	OCE M$
	FY81		
IPF			
	X045 155 XM211 Prop Chg LAP	LAP	1.2
EXP			
	3142V 155 ICM M463 MSAAP Complex	MPT	52.9
MOD			
	2049 155 RAP M549 RKT Grns Mod	P&E	1.9
	2117 Chg Igniter Prep Mod	LAP	.9
	B160 NC Line C Restore-Radford	P&E	.8
OMN			
	0000L Omnibus OCE		5.9
		TOTAL	63.6
	FY 82		
IPF			
	2928B FAE2 LAP	LAP	.7
MOD			
	2820 CBU Line D Mod	P&E	7.9
	B052 Comp B Line 1 Improv	P&E	12.1
	2317 Weatherly AOP Mod	P&E	4.9
OMN			
	0000M Omnibus OCE		8.7
		TOTAL	34.3
	FY 83		
IPF			
	X028 120 Tank Propellant	P&E	3.2
	B053 Granular Composition B IPF	P&E	8.8
EXP			
	B161 155/8 CTR Core Igniters	LAP	10.1
	B041 Gator LAP	LAP	2.1
OMN			
	0000N Omnibus OCE		9.1
		TOTAL	33.3
	FY84		
MOD	B156 105 to 4.2 HE LAP Conv	LAP	8.7
	B162 Chg Demo Blk TNT Mod	P&E	10.1
	2390 Cont NC Mfg Unit 1	P&E	9.6
OMN	0000P Omnibus OCE		9.9
		TOTAL	38.3
	FY85		
IPF	2719 60/81/4.2/1.55 Illum LAP	LAP	9.8
MOD	B137 FAD Efficiency Mod-Radford	P&E	32.6
	2688 Comp B Line 2 Mod	P&E	13.8
	2999 HMX Special Prod Facilities	P&E	9.8
	3000 RDX Special Prod Facilities	P&E	12.2
	3587 NC Line C Purifmod-Radford	P&E	5.9
OMN	0000Q Omnibus OCE		10
		TOTAL	94.1

3-3. PRIORITIZATION OF FACILITIES

Many types of facilities exist at the various types of plants. All are process dependent to varying degrees. Of the possible types initially considered, the facilities considered most fruitful for study are:

a. Process Control Rooms

b. Local Control Rooms

c. Motor Control Rooms/Centers

d. Interface Rooms

Further study in Phase II may produce additional candidate facilities for standardization.

CHAPTER 4

PLANT AND INDUSTRY SURVEYS

4-1. GENERAL

Familiarization with past and current practices was obtained from plant surveys. Discussions with design, Government, construction and operating contractor personnel yielded valuable information on possibilities for better design approaches. Pertinent information on industry trends was obtained. Additional trend information was obtained from equipment designers.

4-2. PLANT SURVEY FORMS

Plant survey forms were developed as a means of uniformly surveying and documenting the various AAPs. Information concerning appropriate completed forms from the six plants surveyed may be obtained by contacting the US Army Engineer Division, Huntsville (HNDED-FD). The following paragraphs of this chapter describe some of the more significant results of the surveys.

4-3. INDIANA AAP

a. General. The Black Powder IPF was visited in conjunction with another study. However, the information gathered did apply to some degree in this study.

b. Process Control Room. The process control room is located in a process control building separated at some distance from the line. There appeared to be effective use of internal space with some crowding. However, some desks, documents and test equipment will be removed when the line is fully operational. Wiring is routed under a raised floor. The room appears to be a satisfactory model for further evaluation.

c. Electrical Equipment. A separate building housed the 480-volt switchgear and electrical equipment. Design was clean and adequate.

d. Equipment Room. An equipment room adjoined the process control room. This design approach appeared to be satisfactory.

e. Plant Security. Plant security was centralized in the guard or change house rather than in the control room.

f. Maintenance Shops. The maintenance shops were located a significant distance from the control room.

4-4. RADFORD AAP

a. General. The areas surveyed included the following:

(1) Nitrocellulose "B" and "C" lines

(2) Finishing area remote transfer house control house

(3) Acid area

(4) Nitroglycerine mix

(5) Incinerator control room

(6) Single base facility

b. Nitrocellulose "B" and "C" Lines.

(1) General. Both lines are basically the same.

(2) Process Control Room. The process control room is located in the continuous nitrator building. The continuous nitrator is controlled by this control room. Also in the building are the motor control center (MCC) room and the refrigerant room (for the next building). The MCC room and the process control room occupy the second floor. Concrete block construction is employed with a poured concrete roof. The floor is tile over concrete.

Hercules provided the main control panel. This panel occupies only a small portion of the control room. However, a wooden room within the control room isolates the operator from the remaining portion of the room. Two additional outboard panel sections were added for expansion. Operating contractor personnel commented that these sections should have been turned in for better operator visibility instead of being in-line. A television monitor is provided to monitor operations. Communications include a plant phone and an intercom. Cables are routed from overhead cable trays. Three rows of fluorescent lights are located 4 feet below the ceiling.

Fire protection is provided by CO_2 fire extinguishers. The heating, ventilation, and air-conditioning (HVAC) unit is separate for this building. Air is dried for instrument air.

Although termed a process control room, this room does not control all functions. Some local control functions are necessary. Controls are analog.

(3) Local Control Room. A local control room provides control for centrifuges. It is located in a hazardous area in one corner of the centrifuge building. Reinforced concrete construction is used; the room is blast proof.

DeLaval control panels are used. Heat is provided by a radiant heater. Ventilation is to the outside. Standard emergency lights are used.

(4) Motor Control Center. The MCC is located in a room adjoining the process control room. Standby power from the power house feeds the MCC for critical operations. If this circuit fails, a portable generator provides power.

c. Finishing Area Remote Dump Transfer House Control House. Simple control rooms provide control for two dumpers. Each is earth mounded and steel lined through use of discarded acid tanks. Controls are located on a small control panel. Telephone, heat and ventilation are provided.

d. Acid Area.

(1) Sulfuric Acid Plant. The control room for this plant is located on the first floor of a separate control building. The structure is of concrete block construction. The control panel is of 1972 vintage. Power and wiring are fed from above. An emergency generator is provided for the emergency lights. Fire protection is afforded by CO_2 extinguishers on the outside of the building. The MCC room is in an adjoining room. The ceiling for both rooms is a drop ceiling, and the floor is concrete.

(2) NAC/SAC Control Room. This control room is representative of several in the area. It is a separate building of concrete block construction with a concrete floor. It includes a drop ceiling, fluorescent lights and HVAC. Wiring and tubing for pneumatic controls are furnished from above. Fire protection is provided by a wall-mounted fire extinguisher.

Motor controls are located in a motor control room — an annex to the NAC/SAC building. Conduits are routed from above. An emergency generator is located in this building. It furnishes power for emergency lights. Most buildings in this area are designed to shut down if power is lost.

e. Nitroglycerine Mix. Nitroglycerine mix is accomplished as a manual operation -- an operation that is primative at this facility which has not been modernized. The modernized Radford facility was destroyed by an explosion.

f. Incinerator Control Room. The incinerator control room is located in a concrete building which is earth mounded. It is basically different from other control rooms at the plant. Power and control lines are routed in overhead cable trays. There is a fire alarm system and emergency lights. Operations are monitored by remote TV.

g. Single Base Facility.

(1) General. Much information was obtained at the single base facility. This information represents a design of the 1971 to 1974 period. Revision and debugging changes represent the current time period. The elements of a complex system are represented in this plant. Discussions with operating personnel provided useful information in two particular areas. First, it was noted that certain changes to the facilities, as designed, either would be made or would be desirable, based on installed equipment and present knowledge. Secondly, with knowledge of present generation equipment, changes can be shown that would be made in the design if it were accomplished today. Using original design data as a point on a curve and using present information as a second point on the curve, this facility can be used to indicate the developing trends in designs and requirements.

(2) Process Control Room. The control room is located in a building which also houses an office, support areas, maintenance shops and storage. The size of the control room is approximately 40 x 45 feet. Access is provided by a double door. Some windows are located near the door but serve no functional purpose. Air-conditioning is furnished by two contained air-conditioning units. Operating personnel suggested that future designs should provide for the location of the air-conditioning units outside the control room to reduce noise and improve maintenance access. Some sound absorbing material has been added to the bare walls to reduce noise. Blowers and fans are the major sources of noise. Although the noise levels are low by absolute standards, the levels become objectionable during the long periods that an operator must remain on duty.

The equipment to be installed in the room was adequately known at the time of the design. The entire system was furnished by Foxboro. Major components include a digital computer, 8 A/D racks, an operator console and analog backup boards to bring the plant down in the event a failure of the computer. A closed circuit TV system is used for monitoring.

added to handle equipment heat loads. It was reported that the equipment was supposed to be furnished with its own cooling. However, the installed equipment did not have internal cooling. Thus an extra air-conditioning unit had to be added.

c. Primer Insert Control Room. The primer insert control room is located in a hazardous area. The walls of the room are constructed with concrete block. HVAC is supplied from the plant system.

d. Load and Assemble Control Room. The load and assemble control room is similar to the primer insert control room. All utilities are fed from above.

e. Process Quality Control System Room. The process quality control room does not control the process. It only monitors the quality of the product. However, the room and the equipment contained therein are representative of a control room. Walls are of concrete block construction. Central to the room is a large computer. Wiring is routed under the raised floor. An additional air-conditioning unit handles the equipment heat load.

4-6. LONESTAR AAP

a. Melt Pour Facility Control Room. An existing building, E-20 change house, was modified to incorporate a control room. A raised floor was added to provide space for wiring. Ceiling height was limited by the existing structure; thus a space of only four inches is available above the new drop ceiling. Air-conditioning was added.

Only a few pieces of equipment were installed at the time of the survey. Allen-Bradley programmable controllers are being installed. Next generation units which are smaller are now available for future designs. A Halon fire protection system and a TV surveillance system were being installed. An Uninterruptable Power System (UPS) will be added in the same building.

b. Process Control Room-Detonator Line P. The control room was located in an existing building. Aluminum panels were used to cover the walls and ceiling. Some buckling was noted; tape was used to seal the buckled seams. Equipment racks were mounted on a false floor. Allen-Bradley programmable controllers were used. Six racks contained blowers and three did not. CSC manufactured the computer. Foxboro furnished the system. HVAC was supplied by the central air-conditioning system.

The equipment room was an adjoining room. It contained I/O circuits, motor control centers and an air handling unit.

4-7. LOUISIANA AAP

a. Control Room for Heat Treat Furnace. The control room was manufactured by Reliable Source of Metalwork, Inc., Youngstown, Ohio. The room was mounted on a slab poured over the existing concrete floor. The location of the room is in a non-hazardous area. Service Combustion furnished the room and the equipment therein as a turn-key job. Included were all controls and MCCs.

A standard drop ceiling is used with recessed fluorescent lights and vents. All utilities are delivered from above. Two doors are located at opposite ends of the room. The furnace may be viewed from four glass windows. Fire protection is afforded by portable fire extinguishers.

b. Control Room-155 MM Line. This room is similar to the heat treat furnace control room mentioned above except that it provides control for three furnaces. The windows in this room are non-functional. Two problems were noted in this room that were found in several others. First, a water leak problem exists. The room is located in an old building, and the roof leaks. The second problem is that according to operating personnel, the room cannot be effectively laid-away. Future designs need to accomplish effective moisture/humidity sealing.

Adequate drains were not provided. Equipment cabinets are of open construction and difficult to seal. Plastic sheets were taped over each rack in order to layaway this room. This operation was very inefficient and provided little long term protection.

c. Billet Heating Control Room. The billet heating control room is elevated; no other location appears feasible. This room is similar to the heat treat furnace control room.

d. New Control Room. A new control room is being added to an existing office area. No major modifications are being made to change the existing appearance. Two Allen-Bradley programmable controllers were being installed at the time of the survey. Conduits are run through the upper side wall; the wall is used for conduit fan-out. Flexible conduits tie the rigid conduits to the terminal equipment.

4-8. SUNFLOWER AAP

a. Calcium Cyanamide Control Room. The control room is located on the second floor adjacent to a hazardous area. No penetrations exist

through the wall to the hazardous area. Good space utilization exists. There are two viewing windows on one wall. There are two major equipment racks. However, one is slightly higher than the drop ceiling. All utilities are furnished from above. One console has walk-in access. The air-conditioning diffusers were not yet connected at the time of the survey; limited room exists above the drop ceiling, and there are a large number of conduits located there. Thus, the connections to the diffusers will have to be custom-made. The floor is concrete.

b. Relay/Interface Room. The relay/interface room includes batteries, a static inverter and motor controllers. Fire detectors are located in the ceiling. The UPS will come on line when commercial power drops out prior to the emergency generator coming on line.

c. Motor Control Center Building. It is not obvious why the MCC building is a free standing building separate from the main building. It can be surmised that this approach was taken to separate the MCCs from a hazardous area. The building is a free standing metal building. There is good space utilization within. Several such buildings are located around the plant.

d. Wet Guanadine Nitrate Control Room. This room is located on the upper floor of the concrete block building in a hazardous area. Everything was designed to be explosion proof, even the fluorescent lights. Foxboro was responsible for the various controls. Access to the equipment is from the bottom. Fire detection is located above the drop ceiling.

e. Wet Nitroguanadine Control Room. This control room houses the same console as housed by the wet guanadine nitrate control room, but room construction is different. There is no drop ceiling nor air-conditioning, and the room is not sealed. No fire detection is used. Also, the console is too large for the room. This type of problem was noted in several locations. Space for control panels may have been sized based on the number of control functions used with a process. Space was not allocated for rack mounting nor for the racks themselves. Thus, the consoles extended into door openings of doors opened against the panels.

f. Dry Nitroguanadine Control Room. The dry nitroguanadine line has a small control room. It does not have a drop ceiling but does have ducts for HVAC.

g. Sulfuric Acid Concentrator Control Room. In several ways this room differed from other similar rooms at this plant. A Foxboro console was used but was of different size, shape and color. Windows were located on both sides of the room but they were not functional. The equipment rack was mounted on a concrete pad. Much more room was available from the roof to the drop ceiling.

h. Motor Control Center. The motor control center room was located within the same building.

4-9. INDUSTRY SURVEY

a. General. Industry was surveyed to determine trends in new equipment designs, changes necessary to incorporate these designs and the type of data that may be available from industry that can be obtained during Phase II. During Phase II each of the major manufacturers can be surveyed to obtain the current trend data.

Information obtained verified that control panels vary considerably among the several types, i.e., analog, digital, pneumatic and hard-wired. Hard-wired panels have instruments/controls wired directly to terminal equipment. Devices from different manufacturers add to the variation in installed equipment. However, once the instrumentation system is selected and the planned installation time frame is known, the information can be obtained to properly specify the facility design.

Motor control rooms are tied to starters and motor control centers. Information obtained indicated that no significant changes will be made in this area in the foreseeable future.

Data obtained from two manufacturers, i.e., Fisher Control and Honeywell, Process Control Division, can be considered representative of the type of information obtained and an indicator of trends in design.

b. Fisher Control. General design approaches were discussed to assess the type of information that is available for use in standard designs or design methodology. Also, data on future trends in equipment design were obtained.

As an initial consideration in a design the designer must have a fairly firm idea of the type of control system to be used, i.e., digital, analog, pneumatic or hard-wired. Once this is known, then the number of instrument loops required and the type and number of devices to be used in each loop must be determined. The number of panels required is determined by the number of devices and the density of devices on a panel. A standard panel is 24 inches wide and 7 inches high. Devices are 1 inch wide and 6 inches high. Allowance must be made for racks and panel attachment when calculating height and length of racks for a proposed installation. These factors were not considered in sizing some of the designs which were surveyed.

For most designs only three racks are used plus one annunciator and one recorder rack. Nothing is located below 28 inches from the floor. Space on the front of a panel is a limiting factor -- not the wiring behind the panel. Hand-on-auto pushbutton with lights may be 4 inches by 6 inches.

Cable entry depends to some degree on the type of controls and panels used. Desk-type controls use bottom cable entry from an embedded tray or a raised floor. The raised floor has the advantage in that equipment size, location, number of wires and placement do not have to be known at the time of facility design. For panels the cable entry may be from the top or the bottom with no specific preference.

In the future more computer control CRTs will be used but manual backup will remain at least for critical functions. Not much reduction in overall size is anticipated from present state-of-the-art equipment.

c. Honeywell, Process Control Division. Much of the information obtained from Honeywell was of a nature similar to that obtained from Fisher except that it reflected the requirements appropriate to a specific manufacturer. For example, control is by analog signals. Cabinets are 19 inches wide; racks are 6 inches high. A normal design would use only three racks to be in range of an operator's reach. One more may be used for viewing only. Equipment density would include nine controllers or three recorders per rack.

Future trends will reflect greater use of micro processor digital-type control. The operator console will be desk mounted but will have peripheral input-output equipment.

CHAPTER 5

RESULTS AND CONCLUSIONS

5-1. GENERAL

a. Select Control System Facilities. This study has determined that it appears feasible to standardize certain features of select control system facilities. Those facilities are:

(1) Process Control Rooms

(2) Local Control Rooms

(3) Motor Control Centers/Rooms

(4) Interface Rooms

Paragraphs 5-2 through 5-5 outline the proposed standardization as it applies to each facility.

b. Categories of Facility Features. It is recognized that an additional more in-depth review of these and other features will be conducted during Phase II. However, this list should be considered representative and indicative of the proposed approach to standardization. Each feature is presented as appropriate under one of the following four categories:

(1) Structural Aspects

(2) Support Systems

(3) Safety Systems

(4) Security Systems

In the following paragraphs standardization of facility features is summarized in tables. In the text, each proposed standardized (STD) feature is presented with its need and justification (N&J) followed by further detail provided by the supporting explanations.

5-2. PROCESS CONTROL ROOMS

a. General. A standardized approach to the design of process or central control rooms appears feasible. Standardization of process control room features is summarized in Table 5-1. Further detailed

Table 5-1. Process Control Rooms - Standardization of Features.

FEATURE CATEGORY	STANDARDIZED FEATURE	NEED AND JUSTIFICATION
Structural Aspects	(1) Size may be determined based on the number and type of controls used.	Optimum size determined early in the design will result in a cost effective design which will effectively accommodate user installed equipment.
	(2) Design approach may be determined based on the type of controls used.	Much is known about the basic design and configuration of a control room once the type of control system is selected.
	(3) Ceiling height.	If the ceiling is too low, clearance is a problem. If too high, the design is not cost effective.
	(4) Ceiling design/configuration, space above drop ceiling.	Each ceiling design requires extensive coordination with all items above and below the ceiling.
	(5) Example approach.	One to three designs should be developed to minimize the various alternatives.
	(6) Floor	A minimum number of optimum cost effective designs should be developed based on information currently available.
	(7) Door and window design and placement.	Each design may consider doors and windows for various reasons. One or two coordinated designs based on field experience should suffice.
	(8) Room location.	A systematic approach to determining room location is necessary.
	(9) Construction.	Guidelines for type(s) of construction should be cost effective.
	(10) Noise level considerations.	Noise level is proportional to the density of electronic equipment in a control room.
	(11) Configuration-building.	A standardized approach should be followed to optimize the configuration of the control room/building.

Table 5-1. Process Control Rooms - Standardization of Features (Cont'd).

FEATURE CATEGORY	STANDARDIZED FEATURE	NEED AND JUSTIFICATION
Structural Aspects (continued)	(12) Layaway.	Many plants are designed, built, made operational and then put in a layaway condition.
	(13) Design coordination.	Standardized design approaches could be fully coordinated before a design is implemented.
	(14) Hazardous/Nonhazardous.	The structural design approach is dictated by the environment in which it is to be located.
Support Systems	(1) Quality of power.	Quality of power is a consideration in all process control rooms.
	(2) Uninterruptable power system(s) (UPS).	Many types of UPS exist in the field. There also is a wide variation in reasons for intended use.
	(3) Room lighting.	Each design requires a new design for the lighting system. One to three designs should suffice.
	(4) Energy monitoring and control system (EMCS)	EMCS will be reflected in all new designs. A standard approach is appropriate.
	(5) Conduit egress.	Wireways serve all control rooms. Several designs would probably serve all new applications.
	(6) Air conditioning/HVAC.	HVAC is a significant factor in all designs.
	(7) Approaches to equipment cooling.	All electronic equipment installed within the control room will require some degree of cooling.
	(8) Communications.	Several concept designs should be developed to cover all normal situations. There is no known reason for custom designs for each new application.
	(9) Environmental control/human factors.	Control of the total environment for operating personnel should be standardized.

Table 5-1. Process Control Rooms - Standardization of Features (Cont'd)

FEATURE CATEGORY	STANDARDIZED FEATURE	NEED AND JUSTIFICATION
Safety Systems	(1) Fire detection.	The need for fire detection is common to all designs.
	(2) Fire protection.	The need for fire protection is common to all designs.
	(3) Grounding.	Grounding is a very basic part of all designs. A standard approach is not apparent in the field.
	(4) Lightning protection.	Lightning protection will be coordinated with the results of HNDTR-80-40-ED-FD.
Security Systems	Methodology for designing security systems.	Security is a factor in all designs.

supporting explanations are provided in Paragraphs b through e below. Examples of new process control rooms are found at the Indiana AAP Black Powder Facility and the Radford AAP Single Base Line.

b. Structural Aspects

(1) STD

Size may be determined based on the number and type of controls used.

N&J

Optimum size determined early in the design will result in a cost effective design which will effectively accommodate user installed equipment.

From a size consideration standpoint a process control room consists of:

(a) Computer(s)

(b) Back-up Controls/Panels

(c) Process Control Panels

(d) Maintenance Items

(e) Operator Interface Unit(s)

(f) Security System(s)

(g) Operator(s)

(h) Communication

Specification requirements for each entity are governed by the process employed. Selection of a supplier for the process control system will in general dictate the general size, layout, placement and support requirements of the control equipment. Knowing the time frame in which the equipment will be installed will provide a firm indication of the specific details, density and support requirements for the equipment. Further study of the factors governing size should result in the development of an empirical formula which can be used to size a room.

(2) STD

Design approach may be determined based on the type of controls used.

N&J

Much is known about the basic design and configuration of a control room once the type of control system is selected.

Control panels vary considerably among manufacturers. Instrumentation-readout/control devices are becoming more compact. Density of instrument distribution on panels also has significant variance. Accurate trends cannot be established for all control panels as a single group. However, if each type is considered independently, a more accurate projection is possible. Thus, control panels/systems should be addressed as being of one of the following types:

(a) Analog

(b) Digital

(c) Pneumatic

(d) Hard Wired

Each type can be considered as having its own packaging and support requirements.

(3) STD	N&J
Ceiling height.	If the ceiling is too low, clearance is a problem. If too high, the design is not cost effective.

Surveys have shown that a variation in ceiling height exists in the field. Field modifications were required to accommodate racks which were higher than the ceiling height. This problem also became apparent when ceilings were not coordinated with floors and/or equipment footings.

(4) STD	N&J
Ceiling design/configuration, space above drop ceiling.	Each ceiling design requires extensive coordination with all items above and below the ceiling.

Sufficient room must be provided for utilities above the ceiling and fire detection/protection if they are applicable. Some field examples showed insufficient room for normal treatment of the utilities which were installed in or above the ceiling. However, it should also be remembered that whatever space exists above a drop ceiling of an air-conditioned room will also require air-conditioning. If the rattlespace above a drop ceiling is subject to blast overpressure, solid lay-in panels should not

be employed. An explosion at Radford AAP caused the ceiling panels to drop due to overpressure above the drop ceiling. Another field example indicated insufficient space available above the ceiling for normal installation of HVAC ducts and electrical conduits.

(5) STD	N&J
Example approach.	One to three designs should be developed to minimize the various alternatives.

An example approach would be to use an egg crate-type drop ceiling. Fluorescent light strips could be placed some distance above the ceiling panels making their location relatively insensitive with respect to equipment placement below. Black/non-reflective egg crate ceiling panels could be placed over operator interface consoles, after the equipment is installed, to reduce light levels as desired. Heat, smoke or fire sensors could be placed above the drop ceiling to serve the area above and below the ceiling. HVAC outlets could be placed at convenient locations in the rattlespace negating the need for information on specific location of equipment in the control room.

(6) STD	N&J
Floor	A minimum number of optimum cost effective designs should be developed based on information currently available.

Discussions with appropriate personnel have indicated that raised floors will continue to be required in complex process control rooms. The number and random lay of interconnecting cables require raised floors with removable panels. A standard design should be developed. Corner posts or jacks at each removable panel should be tied together both longitudinally and latitudinally. Experience has shown that if the posts are not secured, they can collapse. A standard floor height should be used. HVAC design will be coordinated with the floor design.

(7) STD	N&J
Door and window design and placement.	Each design may consider doors and windows for various reasons. One or two coordinated designs based on field experience should suffice.

Field surveys have shown various combinations of doors and windows used on the many designs. Few combinations if any could be considered optimum designs based on discussions with operating personnel. A standardized approach might consider a room without windows with a double-door entry. Windows and doors restrict equipment design and placement.

(8) STD	N&J
Room location.	A systematic approach to determining room location is necessary.

A control room could conceivably be located anywhere at a plant. One exception is the maximum safe distance requirement which must be adhered to. The presence of hazardous environments must also be considered. Experience has shown that certain locations are both more desirable and cost effective than others. Plant security and visitor control are usually tied to control room placement. Construction and configuration are dictated by location.

(9) STD	N&J
Construction.	Guidelines for type(s) of construction should be cost effective.

Hardened rooms could be designed to specific or general guidelines. Rooms located in a new or existing building could be designed to specific guidelines. Normal free-standing rooms could be designed in accordance with specific goals rather than be left to an infinite number of design possibilities.

(10) STD	N&J
Noise level considerations.	Noise level is proportional to the density of electronic equipment in a control room.

As the complexity of control rooms increases, more equipment is needed. Dense packaging of solid-state electronic equipment requires significant air flow. Internal equipment (air) fans can result in objectionable noise levels. Even low levels of noise become a problem when the long periods of time are considered that an operator is required to remain on duty. Equipment cooling should be coordinated with room design, equipment design and room HVAC. Sound absorbency should be considered in the design of walls and ceilings in complex rooms.

(11) STD | N&J

Configuration-building.

A standardized approach should be followed to optimize the configuration of the control room/building.

The simplest form of control room building/configuration consists of a control room only. More extensive examples include an adjoining motor control center and an interface room, while more complex buildings include shops, office areas and eating facilities. In determing which of the various configurations would be the most appropriate for a certain facility, a systematic approach should be developed which would enable a designer to site-adapt the optimum concept to suit that facility.

(12) STD | N&J

Layaway.

Many plants are designed, built, made operational and then put in a layaway condition.

Field examples have shown that insufficient consideration appeared to be given to the design of facilities with respect to the possibility of their eventual layaway. A study should be conducted of the factors to be considered in implementing a cost effective layaway. Results of this study could be documented as a standardized approach to layaway. All appropriate factors then could be factored into the design(s).

(13) STD | N&J

Design coordination.

Standardized design approaches could be fully coordinated before a design is implemented.

The most cost effective designs result from an initial proper coordination at the earliest possible time with periodic coordination during the development of the design.

(14) STD | N&J

Hazardous/Nonhazardous.

The structural design approach is dictated by the environment in which it is to be located.

Guidelines formulated could be used to locate a control room with regard to hazardous environments. Further, guidelines could be developed for designs in hazardous and nonhazardous environments.

c. Support Systems.

(1) STD	N&J
Quality of power.	Quality of power is a consideration in all process control rooms.

Quality of power will vary. Some standard approach to handling this question is desirable.

(2) STD	N&J
Uninterruptable power system(s) (UPS).	Many types of UPS exist in the field. There also is a wide variation in reasons for intended use.

Field surveys uncovered wide variations in types and applications of UPS. Each design should not result in a new UPS. Standard designs could be developed for the several major applications.

(3) STD	N&J
Room lighting.	Each design requires a new design for the lighting system. One to three designs should suffice.

Good and bad experience with existing control rooms should be factored into standard designs, as appropriate. Field surveys have shown lights in wrong locations, insufficient control over existing lights and a diversity in designs.

(4) STD	N&J
Energy Monitoring and Control System (EMCS)	EMCS will be reflected in all new designs. A standard approach is appropriate.

A standard approach to EMCS would serve the goals of EMCS in an efficient manner.

(5) STD

Conduit egress.

N&J

Wireways serve all control rooms. Several designs would probably serve all new applications.

Conduit egress is often dictated by the type of equipment to be installed and the basic design/location of the control room. Knowing the several factors which dictate efficient placement of conduit egress will allow standard designs to be developed which will serve future equipment designs.

(6) STD

Air conditioning/HVAC.

N&J

HVAC is a significant factor in all designs.

Field surveys have indicated many approaches to HVAC. Often significant modifications were made in HVAC after control equipment was installed. Air conditioning units were either improperly sized or improperly located or both. Much information is now available to design relatively optimum systems. HVAC designs must be coordinated with virtually all design specialties. For example, raised floors or dropped ceilings will directly affect duct design. Also, placement of an air conditioner inside a control room will raise the ambient noise level above what it would be if the unit were placed outside the control room. Often it is necessary to have the control room HVAC either separate from the central system or locally controlled. Toxic fumes of fire make local shut-off from the central system necessary.

(7) STD

Approaches to equipment cooling.

N&J

All electronic equipment installed within the control room will require some degree of cooling.

The design should reflect the particular cooling needs of the equipment which eventually will be installed. Coordination is required with the various specialties but especially with the design of the HVAC system. It would be appropriate to perform this coordination in conjunction with several standard designs.

(8) STD	N&J
Communications.	Several concept designs should be developed to cover all normal situations. There is no known reason for custom designs for each new application.

Interplant and intraplant communications are found at virtually all plants. Standard designs should be developed which cover these situations. Plant experience incorporated into these designs will provide more satisfactory cost effective designs. Control room size and layout are affected to some degree by communications considerations.

(9) STD	N&J
Environmental control/ human factors.	Control of the total environment for operating personnel should be standardized.

Excessive heat, abnormally cool temperatures and/or constant noise may desensitize operators. Performance will be affected.

d. Safety Systems.

(1) STD	N&J
Fire detection.	The need for fire detection is common to all designs.

Several fire detection systems could be developed which would cover virtually all applications. Detectors may include fire, smoke, fume or other such units. Standard designs would address types of units to be employed in various situations, their number, placement, location, and ancillary equipment. Standard fire detection concepts require coordination with both the floor and ceiling designs.

(2) STD	N&J
Fire protection.	The need for fire protection is common to all designs.

The approach may vary but the need is common. Several basic designs should be developed with possible variation of each being a consideration.

Halon is a definite candidate for a standard system. It provides rather immediate control of a fire while allowing for the orderly evacuation of operating personnel.

(3) STD

Grounding.

N&J

Grounding is a very basic part of all designs. A standard approach is not apparent in the field.

The handling of grounding for all designs should be standardized. Certain specifications and standards already address grounding and bonding. Each of the various documents should be reviewed and the appropriate parameters selected for application on future designs. It is a fact that some approach will be selected in all future designs. It is safer and more cost effective to follow a well planned standard approach. Grounding is becoming more critical with the advent of low-level logic circuitry.

(4) STD

Lightning protection.

N&J

Lightning protection will be coordinated with the results of HNDTR-80-41-ED-FD.

Results of the lightning study will be factored into the standard designs.

e. Security Systems.

STD

Methodology for designing security systems.

N&J

Security is a factor in all designs.

Field experience provides valuable information on the design of an effective security system. It would be extremely helpful to provide the designer with the information to systematically design a new system application. Some plants include the central monitoring of the security system within the control room. Other plants locate the security system in another building. Guidelines, even if only to resolve the question of security monitoring location, would be helpful.

5-3. LOCAL CONTROL ROOMS

a. General. Many of the recommended standards listed under process control rooms are equally applicable to local control rooms.

Table 5-2. Local Control Rooms - Standardization of Features.

FEATURE CATEGORY	STANDARDIZED FEATURE	NEED AND JUSTIFICATION
Structural Aspects	(1) Ceiling design methodology.	Much variation was noted in the field in ceiling design.
	(2) Floor designs.	A uniform approach to floor design would be helpful.
	(3) Door and window design and placement.	Field surveys uncovered problems in this area.
	(4) Room location guidelines.	Field experience could be used to properly locate local control rooms in new designs.
	(5) Construction guidelines.	Much variation was noted in the construction of rooms.
	(6) Noise level.	Noise level will to some degree dictate the requirements for a room.
	(7) Hazardous vs. nonhazardous designs.	Each condition requires different design approaches.
Support Systems	(1) Conduit egress designs.	Field surveys showed conduits/cable trays entering through the walls, ceiling and floor.
	(2) HVAC guidelines.	Again much diversity was found in this area.
	(3) Control line placement.	Information provided to the designer on control line placement would provide uniformity.
Safety Systems	Fire detection and fire protection.	For most local control rooms there is little attendant fire hazard.
Security Systems	Security guidelines.	Recommendations on design philosophy are needed.

This conclusion is particularly true when the basic design of a local control room approaches the design appearance of a process control room. Recommended standards differ, however, as the local control room becomes a more basic or austere control room.

Standardization of local control room features is summarized in Table 5-2. Further detailed supporting explanations are provided in Paragraphs b through e below.

b. Structural Aspects.

(1) STD	N&J
Ceiling design methodology.	Much variation was noted in the field in ceiling design.

Variations were noted in ceiling design, even in similar local control rooms at the same plant. Badly warped drop ceilings were found in rooms without humidity control. Some rooms had drop ceilings, others did not. A cost effective approach should be developed which would provide cost effective guidelines to a designer.

(2) STD	N&J
Floor Designs.	A uniform approach to floor design would be helpful.

Surveys indicated some variation in floor design but also much consistency. The standard concrete floor on which the room is mounted could be recommended. Circumstances which could cause a variation in this approach could be noted with the standard attendant details recommended.

(3) STD	N&J
Door and window design and placement.	Field surveys uncovered problems in this area.

Doors were often improperly located. Some rooms had viewing windows which had no functional purpose. Much variation was noted in door and door hardware design. Often there was not an optimum design for the application. Experience in the field should be incorporated into several standard designs.

(4) STD	N&J
Room location guidelines.	Field experience could be used to properly locate local control rooms in new designs.

Local control rooms are usually located in close proximity to the lines, or portions thereof that they control. Guidelines serving the location process could be developed.

(5) STD	N&J
Construction guidelines.	Much variation was noted in the construction of rooms.

New construction usually had local control rooms which emulated the same construction of the building in which they were located. Modernized lines may have construction reflecting the type of construction of the parent building or prefab rooms. Some lines had local control functions but no rooms to house the equipment or operator. Guidelines which would provide the necessary answers would be cost effective. Type and size factors of the equipment which will be housed will govern to a large extent some of the basic construction considerations.

(6) STD	N&J
Noise level.	Noise level will to some degree dictate the requirements for a room.

The type of enclosure to be provided based on noise level attenuation would be helpful to the designer.

(7) STD	N&J
Hazardous vs. nonhazardous designs.	Each condition requires different design approaches.

Field experience should be factored into both hazardous and nonhazardous design approaches. Virtually every design parameter is affected by this constraint.

c. Support Systems.

(1) STD	N&J
Conduit egress designs.	Field surveys showed conduits/cable trays entering through the walls, ceiling and floor.

Often installed equipment dictated conduit egress. Various reasons can be found for egress schemes. Probably three standard designs (wall, floor, ceiling) could be developed which would serve all applications.

(2) STD	N&J
HVAC guidelines.	Again much diversity was found in this area.

Several standard designs could be developed which would serve all applications. Guidelines for their applications would be given.

(3) STD	N&J
Control line placement.	Information provided to the designer on control line placement would provide uniformity.

Pneumatic and other control lines are field routed with the same diversity as conduits.

d. Safety Systems.

STD	N&J
Fire detection and fire protection.	For most local control rooms there is little attendant fire hazard.

Simple fire extinguisher designs could be developed. The number, type and placement of fire extinguishers could be specified.

e. Security Systems.

STD	N&J
Security guidelines.	Recommendations on design philosophy are needed.

A security system as simple as a lock and key may be satisfactory for some applications. Full surveillance may be necessary at another site. Guidelines that would dictate or at least narrow the approach would be in order for a particular plant.

5-4. MOTOR CONTROL ROOMS

a. General. Motor control rooms are tied to starters and motor control centers. It was generally concluded that no significant changes will take place in this area in the foreseeable future. Thus, standardization could be developed around present equipment.

Standardization of motor control room features is summarized in Table 5-3. Further detailed supporting explanations are provided in Paragraphs a through d below.

b. Structural Aspects.

(1) STD	N&J
Guidelines for hazardous vs. nonhazardous locations.	Good reference point for starting a design.

Motor control centers (MCCs) can be separated from hazardous locations by building walls. Prefabricated buildings can shelter MCCs. Semi-exposed MCCs housed in equipment cabinets are used. Also, separate rooms in existing buildings can be used for MCCs. Field surveys have shown many approaches to handling motor controls. Several standard designs are now possible. For example, one approach that is fairly common uses a standard prefabricated building that is sized in accordance with the number of MCCs housed.

(2) STD	N&J
Size factors.	It is possible to specify size if the number of motor controls is known.

Once such inputs as the number of control functions, configuration and location are known, a motor control room can be designed.

(3) STD	N&J
Location guidelines.	Guidelines for selecting location would be a definite aid in design.

Guidelines would include the factors and trade-offs to be considered in locating motor controls around a plant. Field experience would be reflected in these guidelines.

Table 5-3. Motor Control Rooms - Standardization of Features

FEATURE CATEGORY	STANDARDIZED FEATURE	NEED AND JUSTIFICATION
Structural Aspects	(1) Guidelines for hazardous vs. nonhazardous locations.	Good reference point for starting a design.
	(2) Size factors.	*It is possible to specify size if number of motor controls is known.*
	(3) Location guidelines.	Guidelines for selecting location would be a definite aid in design.
	(4) Building, open and room designs.	Three basic designs could be developed.
Support Systems	Fire detection and protection.	Several concept designs should be developed to provide the designer with the simplest cost effective approach.

(4) STD	N&J
Building, open and room designs.	Three basic designs could be developed.

Variations of each would be addressed based on site factors and number of motors controlled.

c. Support Systems.

STD	N&J
Fire detection and protection.	Several concept designs should be developed to provide the designer with the simplest cost effective approach.

The approach to fire protection for this type of facility should be straightforward. A standard design(s) should be easy to accomplish. The criticality of some operations may require more sophisticated protection/detection methods. Variations and constraints in requirements would be addressed.

d. Security Systems. Security requirements would be dictated by the specific requirements of the line or facility. Further study would be required in this area before a recommendation can be made.

5-5. INTERFACE ROOMS

No specific recommendations are made for interface rooms at this time. This is an area which is amenable to standardization but probably should be considered following the development of standards for control rooms and motor control rooms. Phase II should address interface rooms and make recommendations accordingly.

Field surveys indicate that many of the recommendations made in Paragraphs 5-2 through 5-4 have application to interface rooms.

CHAPTER 6

IMPLEMENTATION OF STANDARDIZATION

6-1. STANDARDIZATION DECISION

The conclusion of this study is that some degree of standardization is feasible. It is recommended that SARPM-PBM review the contents of this study, evaluate the proposed areas of standardization and develop a prioritized list of those areas which should be subject to further study.

6-2. METHOD OF IMPLEMENTATION

a. Handbook. It is recommended that the instrument that should be developed for the implementation of standardization is a handbook or several such manuals. All of the areas to be considered, background information and field experience would be contained in the document. The document(s) would contain appropriate design concepts, standards and guidelines. Methodology for implementing each phase of a design would be specified.

b. *Phase II Program.* Areas requiring further study will be accomplished as a Phase II effort. During this phase all recommended areas of standardization will be fully developed, evaluated, approved and documented.

A contractor may be selected, based on appropriate background and expertise, to support USAEDH in the accomplishment of the tasks of Phase II. The contractor will be under the direction of USAEDH (HNDED-FD).

c. Coordination. The Phase II program will be coordinated with the lightning study [Reference 2], the Architectural Standard Details Study for AAP Facilities and other such timely and applicable studies to assure that standardization is current. The Phase II program also will be coordinated with all in-house design specialties.

d. Updating. The handbook(s) will be updated periodically to ensure that all standards are current.

6-3. PHASE II TASKS

a. General. The following paragraphs describe the scope of work for Phase II.

b. Develop Preliminary Standardization List. SARPM-PBM will provide a baseline list of features to be considered. The contractor, in conjunction with USAEDH and SARPM-PBM, will review this list and make further recommendations as appropriate. The further recommendations will be based on the experience of the contractor, a review of Phase I, and discussions with appropriate personnel. The list thus developed will serve as the baseline list for Phase II development.

c. Conduct Industry Survey - Manufacturers. An in-depth survey of appropriate equipment manufacturers should be conducted. For planning purposes ten manufacturers should be considered. These should be selected on a priority basis based on present and planned application on the PBM program. Emphasis of the survey will be on design trends and their effect on facility design. Survey sheets should be developed which will provide the desired information on a uniform basis. For example, control room equipment will be surveyed and documented as analog, digital, pneumatic or hard-wired.

d. Conduct Industry Survey - Users. For planning purposes four of the major users of control equipment should be surveyed. Their projected needs, standards and experience should be surveyed and documented.

e. Prepare a Revised List for Coordination. Experience on the above tasks will be used to revise and update the list of standards.

f. Conduct AAP Survey. A survey of up to eight AAPs should be conducted to verify the applicability, appropriateness, accuracy and adequacy of the proposed standards. It is recognized that few if any of the proposed standards will have been implemented at the sites surveyed. However, each facility can be viewed as a prospective implementer of the standards.

g. Develop Standardization. Information gathered and developed in each task shall be analyzed and evaluated. Standards and standardization concepts will be prepared and the best presentation format, e.g., one handbook or several, will be determined. Guidelines will be developed and the optimum in study approach and content will be achieved through coordination of SARPM-PBM with appropriate in-house divisions.

h. Prepare Handbook. The output of Phase II will be a handbook. This manual will serve as the instrument to implement standardization. It may be necessary to prepare more than one manual, e.g., process control rooms, motor starter rooms, local control rooms, and interface rooms. Each major phase of a project will be addressed including criteria, equipment selection and facility design. The document will be prepared in looseleaf form to facilitate updating.

6-4. COST AND SCHEDULE FOR PHASE II

It is estimated that the span of time for Phase II is one year. The schedule for this period is shown in Figure 6-1. The manpower estimate is 39 man-months ($178,620) with the total cost of the project estimated at $190,000 of which $10,119 will be expended for travel. By task, the man-month figure is divided as follows:

a. Develop preliminary standardization list - 2 man-months.

b. Conduct industry survey - manufacturers - 6 man-months.

c. Conduct industry survey - users - 5 man-months.

d. Prepare revised list for coordination - 2 man-months.

e. Conduct AAP survey - 4 man-months.

f. Develop standardization - 9.5 man-months.

g. Prepare handbook - 4.5 man-months.

h. Technical direction - 6 man-months.

6-5. FUTURE TASKS

a. General. For standardization to be most effective it must be current, reflect projected needs and be as useful and extensive as practical.

b. Update Handbook(s). The manual(s) should be updated annually. Field experience and changes in equipment and design trends should be factored into the document(s).

c. Determine New Areas of Standardization. New areas of standardization should be developed as appropriate. Those areas not implemented in Phase II could serve as a baseline for subsequent work.

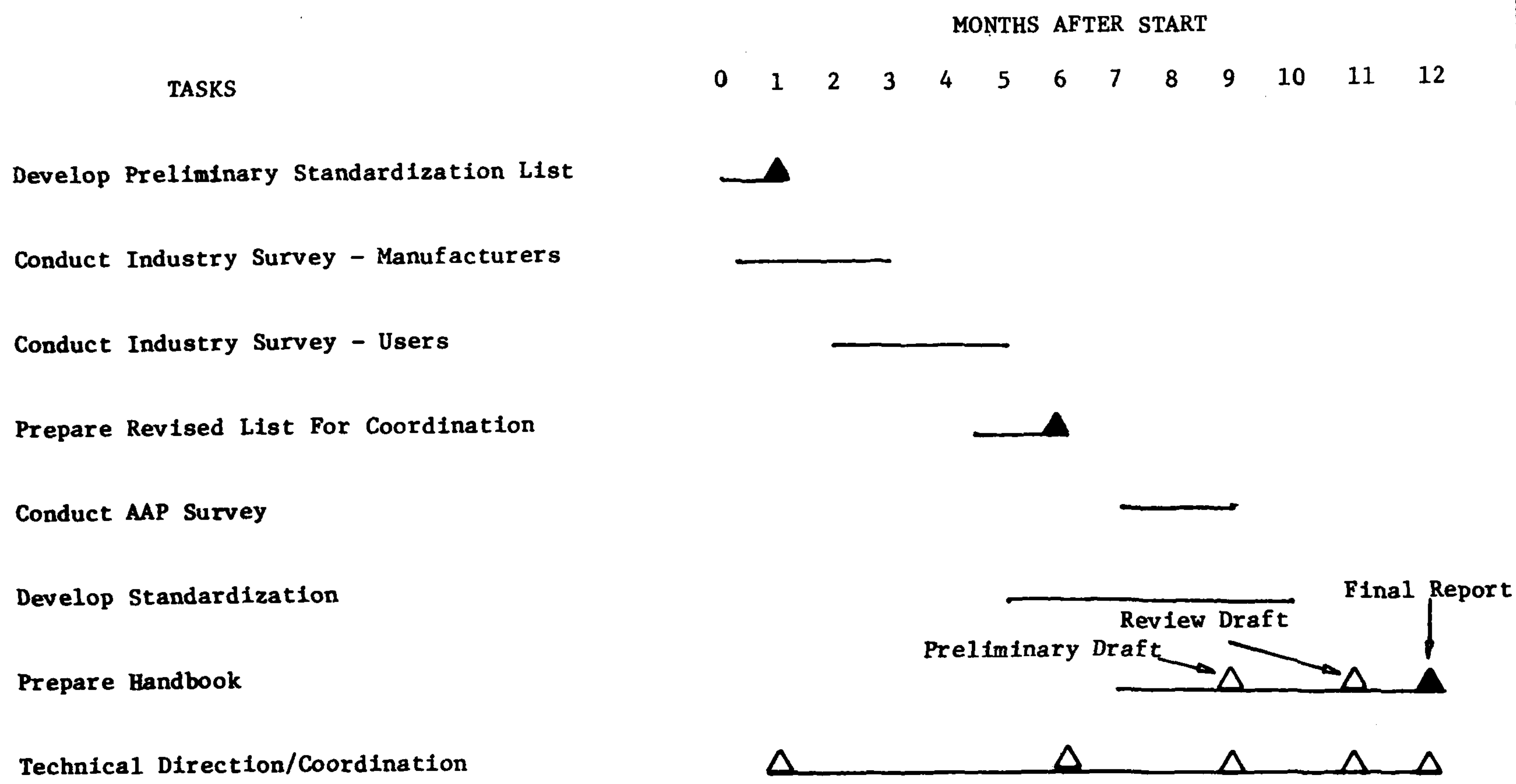

Figure 6-1. Phase II Schedule

APPENDIX

REFERENCES

1. Office of the Project Manager, Munitions Production Base Modernization and Expansion, Dover, New Jersey, "Planned Funding Level and Schedule for the period FY81-FY85," (Modernization and Expansion Plan FY81-85).

2. Franklin Smith (US Army Engineer Division, Huntsville), "Lightning Protection Study US Army Ammunition Plants," Report No. HNDTR-80-41-ED-FD, January 1980.

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